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ABSTRACT

The results of an evaluation of various aspects of the Instructional System in Mathematics (ISM) are presented. ISM is an objectives-based, computer-supported, management system which builds upon a previously developed mathematics curriculum. Questionnaires to school-based personnel and students, in-school observations, and interviews, were used to gather information on the functioning of the system. The evaluation focused on three major components of ISM: the instructional component, the assessment component, and the computer reporting component. The evaluation contains findings and recommendations for each of these components. (MK)

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# An Evaluation of the Instructional System In Mathematics: 1977-1978

DEPARTMENT OF EDUCATIONAL ACCOUNTABILITY

NOVEMBER, 1978

Dr. Charles M. Bernardo
*Superintendent of Schools*

SE 030 139

## EXECUTIVE SUMMARY

During the spring of the 1977-78 school year the Department of Research and Evaluation conducted an evaluation of various aspects of the Instructional System in Mathematics (ISM), the first of four Learner-Centered Management Support Systems planned for implementation in Montgomery County Schools. The ISM is an objectives-based, computer supported management system. It builds upon a mathematics curriculum developed in Montgomery County in the late 1960's and early 1970's. At the time of the evaluation, ISM was in 34 schools--26 elementary, one middle, six junior high schools and one special school. The study employed questionnaires to school-based personnel and students, as well as in-school observations and interviews, to gather a wide range of information on the functioning of the system.

The focus of the evaluation was on the three major components of the ISM: the instructional component--a curriculum and instructional guides; the assessment component--criterion-referenced tests for placement, mastery, and retention; and the computer reporting component--a series of reports on student and class progress.

This report, written by the Department of Educational Accountability presents findings and recommendations for each of the system's components. As a cross-cutting theme, the functioning of the existing computer support system is also evaluated.

### The Instructional Component

Findings:

Analyses indicate that the instructional component--especially the curriculum and instructional guides--has many sound features and is

perceived by staff as being effective and useful. Results on the Iowa Test of Basic Skills, an achievement test, are also encouraging. However, the system is not completely fulfilling its goal of providing individualized instruction--instruction matched to individual student needs. While teachers spend more time in instructional planning, especially for small groups and individual students, and have appeared to increase their use of small group/individual teaching, in too many classes individualized instructional practices are not being implemented. Especially in the junior high schools, whole group instruction, unchanging grouping, and undifferentiated instructional content were reported. The data strongly suggest that there seems to be a need for clarification of the meaning of individualization of instruction and for increased effort to be devoted to aiding teachers in its implementation.

Recommendations:

Given the fact that an important objective underlying the implementation of ISM was to increase individualization of instruction it seems imperative to place renewed emphasis upon helping teachers understand and implement this practice. This may be done by the following means:

- Make it clear to teachers, principals, and teacher specialists that individualization is important to the success of the children in the program. Instruct principals to look for and support behavior which contributes to individualization and its goals.

- Offer sufficient inservice training to teachers to insure that they have the skills necessary to implement a program of

individualization, and to principals to insure that they have the knowledge necessary to assess the efficiency of these activities in the classroom.

- Examine the problems related to time for instructional preparation and assist teachers in decreasing the burden it imposes.

- Require that the Department of Instructional Planning set forth objectives for observed individualization of ISM instruction at both the junior high school and elementary levels; develop a plan for conducting formative evaluations of the progress made in meeting these objectives at each ISM school; and report annually on the results of their formative evaluation activities. Under such a plan, the goal for this year might be that 80% of elementary instruction and 50% of junior high school instruction be observed as being individualized (using number of groups, number of objectives being worked on, etc., as criteria); that the percentages increase to 85% and 70% next year; and that they be 90% thereafter.

- Hold the Department of Educational Accountability responsible for periodically conducting its own evaluations of individualization and reporting its findings to the superintendent.

The Assessment Component

Findings:

The assessment process in ISM is not functioning as it should, and many aspects of it require significant modifications. There is

apparently too heavy a load for aides to handle adequately, and the computer support system as presently designed does not relieve their difficulties. Since test result reporting falls far behind school instruction, teachers must frequently keep their own records on student progress, and thus information fed back to the teacher is of questionable use in instructional planning. Problems with the computer input and feedback system have resulted in an assessment component which appears to be malfunctioning and counter-productive. As with the instructional component, difficulties are especially apparent at the junior high level.

Preestablished procedures relating to group size for testing are not being followed and some questions exist regarding the testing of multiple objectives. Furthermore, when procedures are followed (such as in the lapse of time between instruction and assessment, and between assessment and reassessment) it is not clear that teacher and student needs are being met.

Certain issues regarding the adequacy of the assessment tests themselves continue to raise questions. Of central concern is the constructed response format of the assessments and the resulting scoring burden, which appears to contribute significantly to time delays on feedback. With this format, many available time saving aids to the scoring, such as special scoring keys or optical scanning systems, cannot be used. It is also unclear whether the alternate forms of tests being used interchangeably are, in fact, measuring the same skills.

Recommendations:

The effectiveness of the assessment component is seen as critical to the success of the ISM as a system, since without this component the ISM becomes merely a curriculum package that may or may not be implemented in the manner intended. Given this fact, it is strongly recommended that the following suggestions be implemented:

- Until mechanisms for increasing the flexibility of the the assessment component and relieving the input "gluts" are put into place, no further expansion of the assessment component should be permitted and no new computer terminal schools should be added, even where currently planned for 1979. New schools should implement only the instructional component. This will allow teacher specialists to concentrate on supporting the use of the instructional guides and objectives and on increasing the use of individual and small group instruction. Teachers in schools new to the system should be provided with assessment materials and encouraged, but not required, to use them.
- The assessment component should be redesigned and reconstructed with the goal of having a modified system in place by September of 1979. The schools to be added to the system in January, 1979, may become pilot schools for implementation of this modified system. Remaining new schools plus schools now using the assessment component could be brought over to the new assessment system in September of 1980.

- By January, 1979, some possible variations in assessment procedures should be established in the present set of automated schools so that the effects can be evaluated in the Department of Educational Accountability's study this spring. Of major importance is exploring the feasibility of using forced choice assessment instruments and machine scoring on optical mark forms. Of secondary importance is determining whether centralized scoring and processing of assessments in paper/pencil/schools and in the lower grades in terminal schools is more efficient and cost-effective than is having each school do its own processing.

- Formative evaluation of assessment tests should be conducted.

The Computerized Reporting Component

Findings:

Though the three types of reports produced by the computer are intended to serve different functions, teachers and principals appear to be using (or not using) them in quite similar ways. This suggests that staff may not understand how to use the reports to the greatest advantage. Other possibilities are that they may understand how to use the but, for some reason, fail to apply this knowledge, or that the reports may not provide useful information.

Reporting:

Recommendations:

The fact that differential reports are not provided to principals

and teachers makes the efficiency of the reporting component suspect. Three considerations should guide any modifications:

- Principals need summary and trend data provided in a concise manner at either class or grade level of reporting; they should be receiving reports tailored to these needs.
- Reports should be redesigned so as to reduce their number and permit the needed planning data to be obtained from a single source for teachers and a single source for principals. The development of reports which can serve the purposes for which none of the present reports are being used is probably also indicated.
- Some consideration should be given to the issue of frequency of report publication. As reports are developed to serve different needs, the issue of frequency should be examined carefully.

# AN EVALUATION OF THE

# INSTRUCTIONAL SYSTEM IN MATHEMATICS:

# 1977-1978

by

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with
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Susan Gross
Sharon Shueman
Charles A. Seitz

Department of Educational Accountability

November, 1978

The data on which this report was based were collected and analyzed by Susan Gross and Sharon Shueman.

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## PREFACE

During the 1977-78 school year, the Department of Research and Evaluation conducted an evaluation of selected aspects of the Instructional System in Mathematics (ISM). A report on this study was promised for September, 1978. As a result of central office reorganization, responsibility for ISM evaluation was transferred to the Department of Educational Accountability (DEA). Review of the 1977-78 study by DEA has indicated that both conceptually and methodologically the evaluation has many shortcomings and is far from complete. Despite the fact that a committee made up of members of both the Department of Research and Evaluation and the Department of Curriculum and Instruction worked together to define the evaluation, criteria for selection and exclusion of evaluation areas are unclear. Further, even in areas addressed, survey questions asked appear limited in scope and less than satisfactory in format. Nonetheless, in spite of these limitations, the study does provide some extremely important information on the functioning of selected components of the mathematics system and possible modifications which need to be made.

A more comprehensive study will be conducted during the 1978-79 school year. The new study will provide a more complete picture of the strengths and weaknesses of the system and clarify some of the questions raised by this evaluation and by previous ones.

# CHAPTER 1

# INTRODUCTION AND STUDY OVERVIEW

## A. BACKGROUND

This report presents findings from an evaluation of the Instructional System in Mathematics (ISM). ISM is the first of the Learner Center Management Support Systems (LCMSS) to be implemented in the Montgomery County Public Schools. Systems in the areas of Reading/Language Arts, Social Studies, and Science are currently in the developmental or planning stages and are expected to be introduced to the schools as they become available.

The purpose of this report is to document the strengths and weaknesses of ISM as currently implemented. This information can serve not only to make the mathematics system itself more effective, but also to aid program developers in avoiding some pitfalls as systems in other areas are designed and implemented.

## B. HISTORY OF ISM AND ITS EVALUATION

ISM is sometimes referred to as a recent innovation in instruction. However, neither learner centered management systems in MCPS, nor the mathematics program on which ISM is based, are new to MCPS. Although ISM, with all its components, has been in schools only a couple of years, work on the underlying curricular and assessment items began in July of 1968. The mathematics department, consonant with a trend toward objectives-based instruction which was extremely popular at that time, began to develop a countywide curriculum-by-objectives for mathematics instruction. In 1975, when the Board of Education approved the systems approach to instruction proposed by Superintendent Bernardo, the mathematics curriculum, by then developed and in use, was selected as the first of the areas in which the LCMSS approach would be tried. The curriculum seemed extremely well suited to this effort, as its objectives-based structure was highly congruent with the philosophy of systems management.

From the time of approval to the time of pilot testing in the schools, development of the full fledged system for mathematics progressed quite rapidly. In the spring and summer of 1976, instructional guides were developed, assessment and computer components were added to the basic curriculum, and reporting formats were conceived. Shortly thereafter, schools already familiar with computer instruction through participation in CAI were selected to participate in a small-scale trial of what is now known as ISM. These schools, it should be noted, were not representative of the system, as CAI was generally offered to schools who had significant numbers of low achievers. By the beginning of the 1976-77 school year, the system was being pilot tested in a small sample of schools.

Today, the use of the ISM has been greatly expanded. Two years ago, the pilot year for ISM, the program was in 12 elementary and 3 junior high schools. Now in 1978-79, the program is in 46 elementary, 4 middle, 5 junior high schools, and one special school. Expansion is expected to be completed by the 1979-80 school year, when the system is scheduled to be implemented in all MCPS elementary, middle, and junior high schools.

Despite this rapid growth, quantifiable data on the systemwide effectiveness of ISM are sparse. From the beginning, included as an integral part of the plan for development of ISM, was an evaluation of its effectiveness with costs as well as benefits playing a central role. Under the original plan, a comprehensive and multifaceted evaluation of ISM was to have been initiated during the 1976-77 school year, with the results to have been available approximately a year ago.

However, the only portion of this evaluation which was ever conducted was the questionnaire component of this first year study. The findings obtained by analyzing the questionnaires--which were administered to a subset of principals and teachers working with the system--were documented but the report was never forwarded to the superintendent nor the Board of Education; primarily because the report was perceived as being a formative and partial evaluation product and products of this nature were seldom transmitted to the superintendent or the Board. As best we can determine, neither the superintendent nor the Board were aware that a formal analysis of the findings of the questionnaire effort had ever been developed.

In attempting to determine why the report was not forwarded, it was learned that the primary reason was that it was felt by the then Assistant Superintendent of the Office of Instructional Services, that the questionnaire data by themselves were of very limited utility for anything except for formative evaluation purposes. She felt, after talking with outside project consultants, that the

sample was insufficient in size and breadth and that the questionnaire data alone should not be released as a formal research product since the design for the study called for these data to be only a small portion of the overall research effort. Operating on this assumption, she made use of the findings, informally, in discussions with the superintendent and Board members, but never provided them with the quantitative data themselves or with a copy of the Seitz report. She provided copies of the report to the ISM staff as formative evaluation materials; but she decided to wait for the completion of the second year's data collection and analysis activities--upon which this report is based--before releasing a formal study product. In discussing these events with Dr. Seitz, he indicated that he agreed with this decision and felt that the data were best treated in this manner.

The Seitz report identified many of the problems documented in this report. However, while adjustments were made by the ISM staff based on these data and data collected by the staff themselves, the adjustments did not result in the problems being corrected. As we shall see from the present evaluation, the result has been that certain weaknesses in the system remain.

C. OVERVIEW OF THE PRESENT SYSTEM

ISM is an objectives-based, instructional management system for Grades K-8. It utilizes the MCPS computer to provide information for instructional management, a purpose distinctive from computer assisted instruction where the computer is actually used for instruction per se. ISM is composed of three major parts: an instructional component, an assessment component, and a reporting component. Each is described briefly below.

The instructional component consists of a curriculum for Grades K-8 and a series of instructional guides. The curriculum contains over 190 key objectives broken down by grade appropriateness.[1] The instructional guides, now presented in 17 volumes, are used to support the curriculum package. They identify key objectives, provide assessment linked to these objectives, and suggest instructional activities.

The assessment component consists of three types of criterion-referenced[2] tests: placement tests intended to determine the skills a student has prior to instruction; mastery tests intended to determine whether or not a student has gained sufficiently from instruction to move on to another objective; and retention tests intended to determine how well a student remembers what has been learned. Most tests employ a constructed response format; that is, in responding to test items students must

---

[1]Approximate number of key objectives included in the system at the time of the 1977-78 evaluation.

[2]They are "criterion-referenced" in the sense that they test a small set of exemplar items and are scored as "mastered" or "not mastered" on the basis of some pre-set standard (100% for some tests, 80% for others).

construct, not choose among, answers. Four parallel forms of each test are used interchangeably.[3]

The tests which so far have received the greatest attention from both program developers and evaluators are the mastery tests. There are two types of mastery tests. One type is basically computational and is administered with a pencil-paper format or at the computer terminal. The second type is demonstration, which requires a child to perform a task--such as addition using manipulatives--in the presence of a supervisor. Only some of the schools have the computer component, which consists of a terminal used for presenting and recording student responses, scoring tests, and relaying, for central storage, information on student progress. All schools, however, have a paraprofessional ISM aide whose major function is to administer and oversee testing. The aide administers all demonstration assessments. In schools where paper and pencil tests are provided, the ISM aide is also responsible for test scoring.

The reporting component of ISM is closely related, both technically and theoretically, to the assessment component. Results of mastery assessment are put into the computer. Reports are then produced by the computer and sent to the principals; principals are expected to review these reports before transmitting them to teachers. In theory, the data on mastery of objectives are intended to aid in instructional management. It must be understood, however, that it has never been assumed by ISM developers that teachers should be completely dependent on the data

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[3]These tests have not yet been formally validated. Inter-form reliabilities are not known at this time.

reports for progress. Instead, teachers are supposed to receive immediate feedback on students' mastery or non-mastery of objectives from the aides (or from the students who use terminals via a card) even before the data are fed into the computer. Thus, to at least some extent, the report about individual progress is presently providing data which many of the teachers already have.

Three types of computerized reports are produced regularly: the Class Profile, the Monthly Assessment, and the Student Profile. The Class Profile by Category (Exhibit 1) provides a biweekly summary of class achievement by category of objective, showing for each student the highest-level objective mastered in that category. The Monthly Assessment Report (Exhibit 2) lists all categories of objectives in which assessment occurred and the number of students assessed in each category of objective in the past month. The Student Profile (Exhibit 3) is generated at the end of each grading period and at other times at the request of the teacher. It shows for each student the point at which instruction began in each category of objectives and the last objective by category mastered by the student. Though these regularly-produced reports are aimed primarily at school and classroom level, the data on which they are based can be summarized, and reports can be generated by area and county.

NTGOMERY COUNTY PUBLIC SCHOOLS
ROCKVILLE, MARYLAND 20850

# CLASS PROFILE BY CATEGORY

Exhibit 1

School: EASEWOOD ELEMENTARY SCHOOL

Teacher: MRS. LANCASTER

Grade 4 Group/Period 2

Date: SEPTEMBER 17, 1977

Category: MULTIPLICATION

| | |
|---|---|
| ★ | BASIC PROFICIENCY |
| DEMO | DEMONSTRATION ITEM |
| P-P | PAPER AND PENCIL ONLY |
| M | OBJECTIVE MASTERED |
| @ | OBJECTIVE ATTEMPTED |

| | KEY OBJECTIVE NUMBER AND LEVEL METHOD OF ASSESSMENT | | 01-F DEMO | 04-H | 05-H | 06-I | 07-K ★ | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | ALLEN | KATIE | | | | | | | | | | | | | | | | | | |
| 2 | BROWN | BILL | | | | | | | | | | | | | | | | | | |
| 3 | JOHNS | MARCIA | | | | | | | | | | | | | | | | | | |
| 4 | YOUNG | SAM | | | | | | | | | | | | | | | | | | |
| 5 | MATHIS | ANN | M | @ | | | | | | | | | | | | | | | | |
| 6 | NELSON | NICK | M | @ | | | | | | | | | | | | | | | | |
| 7 | RANKIN | PAM | M | @ | | | | | | | | | | | | | | | | |
| 8 | STEVENS | TERRY | M | @ | | | | | | | | | | | | | | | | |
| 9 | WALSH | RICK | M | @ | | | | | | | | | | | | | | | | |
| 10 | ASHE | JENNY | ---------- | M | | | | | | | | | | | | | | | | |
| 11 | BASCH | DAVE | ---------- | M | | | | | | | | | | | | | | | | |
| 12 | CARR | LYNN | ---------- | M | | | | | | | | | | | | | | | | |
| 13 | GRIFFIN | DEENA | ---------- | M | | | | | | | | | | | | | | | | |
| 14 | MARCUS | JOHN | ---------- | M | | | | | | | | | | | | | | | | |
| 15 | NIBLEY | LARA | ---------- | M | | | | | | | | | | | | | | | | |
| 16 | DORN | SUE | ---------- | M | | | | | | | | | | | | | | | | |
| 17 | GREENE | PAT | ---------- | M | | | | | | | | | | | | | | | | |
| 18 | LANG | MARK | ---------- | M | | | | | | | | | | | | | | | | |
| 19 | SWISHER | ERIC | ---------- | M | | | | | | | | | | | | | | | | |
| 20 | THORNE | ALICE | ---------- | M | | | | | | | | | | | | | | | | |
| 21 | DAY | ANDREA | ---------- | M | | | | | | | | | | | | | | | | |
| 22 | JONES | EDWARD | ---------- | M | | | | | | | | | | | | | | | | |
| 23 | LEWIS | MICHAEL | ---------- | ---------- | M | | | | | | | | | | | | | | | |
| 24 | PIERCE | SANDRA | ---------- | ---------- | M | | | | | | | | | | | | | | | |
| 25 | STEVENSON | PETER | ---------- | ---------- | M | | | | | | | | | | | | | | | |
| 26 | HAYES | SUSAN | ---------- | ---------- | M | | | | | | | | | | | | | | | |
| 27 | THOMPSON | ERIC | ---------- | ---------- | M | | | | | | | | | | | | | | | |
| 28 | REED | KERI | ---------- | ---------- | M | | | | | | | | | | | | | | | |
| 29 | GOLD | NATHAN | ---------- | ---------- | ---------- | M | | | | | | | | | | | | | | |
| 30 | CLARK | JOANNE | ---------- | ---------- | ---------- | M | | | | | | | | | | | | | | |
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SAMPLE DATA

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MCPS FORM 345-30, Revised July, 1977

- ROCKVILLE, MARYLAND 20850

# MONTHLY ASSESSMENT REPORT

Exhibit 2

School: EASEWOOD ELEMENTARY

Grade 4 Group/Period 2

Teacher: MRS. LANCASTER

Date: APRIL

| CATEGORIES (NUMBER OF STUDENTS) ASSESSED | STUDENTS NOT ASSESSED IN ANY CATEGORY |
|---|---|
| MULTIPLICATION (5)<br>DIVISION (21)<br>LENGTH (14)<br>WEIGHT AND MASS (7)<br>GEOMETRIC FIGURES (10)<br>STATISTICAL GRAPHS AND TABLES (13)<br>COORDINATE GRAPHS (2) | BILL BROWN<br>LYNN CARR<br>ERIC THOMPSON |

| STUDENTS READY FOR ASSESSMENT IN PROBLEM SOLVING | |
|---|---|
| NAME | LEVEL |
| ANN MATHIS | F |
| MARK LANG | H |
| ERIC SWISHER | H |
| DEENA GRIFFIN | G |
| PAM RANKIN | G |
| RICK WALSH | F |
| ANDREA DAY | H |
| TERRY STEVENS | G |
| KATIE ALLEN | E |
| KERI REED | I |

| STUDENTS TESTED IN PROBLEM SOLVING | | |
|---|---|---|
| NAME | LEVEL | PERCENT CORRECT |
| NATHAN GOLD | J | 80 |
| JOANNE CLARK | H | 90 |
| MICHAEL LEWIS | H | 80 |
| SANDRA PIERCE | H | 90 |
| JENNY ASHE | G | 80 |

SAMPLE DATA

1.9

**MONTGOMERY COUNTY PUBLIC SCHOOLS**
ROCKVILLE, MARYLAND 20850

# STUDENT PROFILE

Exhibit 3

School: EASEWOOD ELEMENTARY
Teacher: MRS. LANCASTER
Student: JOANNE CLARK

Grade 4 Group/Period 2
Date: APRIL 28, 1977

FOR EACH CATEGORY:
1. ■ - NO OBJECTIVES AT THIS LEVEL
2. ▨ - NO KEY OBJECTIVES AT THIS LEVEL
3. FIRST NUMERAL - BEGINNING OBJECTIVE CURRENT YEAR
4. SECOND NUMERAL - HIGHEST KEY OBJECTIVE MASTERED

Estimated Working Level: 2

| Category (Highest Key Objective) / LEVEL | A (0) | B (8) | C (10) | D (10) | E (16) | F (12) | G (8) | H (15) | I (14) | J (17) | K (14) | L (12) | M (13) | N (7) | O (3) | P (14) | Q (11) | R (6) | LAST DATE TESTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Numeration (30) | | | | | 25--- | | | | --28 | | | | | | | | | | 1/18 |
| Place Value (12) | | | | | | | | | 12 | | | | | | | | | | 9/17 |
| Addition (11) | | | | | | | | | | 11 | | | | | | | | | 9/17 |
| Subtraction (11) | | | | | | | 09--- | | ---------- | --11 | | | | | | | | | 3/11 |
| Multiplication (07) | | | | | | | | 04----- | --06 | | | | | | | | | | 4/18 |
| Division (10) | | | | | | 02-- | | ---------- | ---------- | --07 | | | | | | | | | 4/18 |
| Money (08) | | | | | | | | 04 | | | | | | | | | | | 9/28 |
| Time & Temperature (12) | | | | | | 06-- | | ------- | | --09 | | | | | | | | | 4/01 |
| Length (12) | | | | | | 04--------- | | | --07 | | | | | | | | | | 4/22 |
| Capacity (05) | | | | | | | | 03 | | | | | | | | | | | 4/20 |
| Weight & Mass (06) | | | | | 02--- | | | ---03 | | | | | | | | | | | 3/16 |
| Area & Volume (12) | | | | | | | | | | | | | | | | | | | |
| Geometric Figures (46) | | | | | | | 14 | | | | | | | | | | | | 9/28 |
| Statistical Graphs & Tables (26) | | | | | | | 09------13 | | | | | | | | | | | | 3/07 |
| Coordinate Graphs (10) | | | | | | | | | 03 | | | | | | | | | | 4/25 |
| Common Fractions (32) | | | | | | | 06---------- | | --14 | | | | | | | | | | 3/27 |
| Decimal Fractions (18) | | | | | | | | | | | | | | | | | | | |
| Ratio and Percent (12) | | | | | | | | | | | | | | | | | | | |
| Number Sentences (07) | | | | | | 05-- | | | | --06 | | | | | | | | | 3/15 |
| Factors & Multiples (09) | | | | | | | | | | | | | | | | | | | |
| Estimation & Rounding (09) | | | | | | | | | | | | | | | | | | | |
| Exponents & Scientific Notation (11) | | | | | | | | | | | | | | | | | | | |
| Positive & Negative Numbers (12) | | | | | | | | | | | | | | | | | | | |

SAMPLE DATA

1.10

25

**BASIC FACTS**

| | ADD | SUB | MULT | DIV |
|---|---|---|---|---|
| EASIER | H | H | H | |
| HARDER | H | H | H | |

**PROBLEM SOLVING**

| | |
|---|---|
| LEVEL | H |
| PERCENT CORRECT | 80 |
| DATE TESTED | 3/21 |

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MCPS FORM 345-29, Revised July, 1977

## D. DESIGN OF THE 1977-78 EVALUATION STUDY

The present report is based on selected data collected during the 1977-78 school year, the first full operational year of ISM. The evaluation of ISM examined the program in 34 schools--26 elementary, 1 middle, 6 junior high schools, and 1 special school. Of these, 21 were equipped with computer terminals which are connected by telephone lines to the MCPS computer center.

Two types of data gathering procedures were used: structured in-class observations and questionnaires. Study questions and instruments were developed jointly by the Departments of Curriculum and Instruction and Research and Evaluation.

Teachers, principals, aides, and students were surveyed in the spring of 1978 after the system had been in operation for several months. For teachers, two forms of the questionnaire were developed: a long form for teachers whose schools were in their first year of ISM implementation, and a shorter one for teachers whose schools were in their second year. The questions asked of the different respondent groups varied in content and in format.

Of approximately 500 teachers, 414 (83%) responded, with the majority of responses being from Grades K-3. Twenty-five (75%) of the 33 principals returned surveys, and 33 (94%) of the 35 aides also responded. Eight hundred sixty seven students in Grades 408 were surveyed; slightly more than half (54%) were in their first year of ISM, and 66% took their mastery assessments by computer terminal. Characteristics of respondents are found in the attached Tables 1, 2, and 3.

Table 1

Distribution of Respondents by Grade

| Teachers | N | % |
|---|---|---|
| Gr. K-3 | 183 | 44 |
| Gr. 4-6 | 160 | 39 |
| Gr. 7-8 | 39 | 9 |
| Combined grades | 32 | 8 |
| TOTAL | 414 | 100 |
| **Students** | | |
| Gr. 4 | 175 | 20 |
| Gr. 5 | 188 | 22 |
| Gr. 6 | 203 | 23 |
| Gr. 7 | 164 | 19 |
| Gr. 8 | 137 | 16 |
| TOTAL | 867 | 100 |

Table 2

Distribution of Respondents by Year of ISM[a]

| | First Year | | Second Year | | TOTAL | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Teachers | 258 | 62 | 156 | 38 | 414 | 100 |
| Principals | 11 | 44 | 14 | 56 | 25 | 100 |
| Aides | 18 | 46 | 15 | 44 | 33 | 100 |
| Students | 468 | 54 | 399 | 46 | 867 | 100 |

[a] Year of ISM refers to the number of years the school has been participating in the program.

Table 3

Distribution of Respondents by Computer Terminal Availability

| | Terminal Available | | Not Available | | TOTAL | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Teachers | 172 | 42 | 242 | 58 | 414 | 100 |
| Principals | 15 | 60 | 10 | 40 | 25 | 100 |
| Aides | 20 | 60 | 13 | 40 | 33 | 100 |
| Students[a] | 572 | 66 | 295 | 34 | 867 | 100 |

[a] Students were asked to tell whether or not they used the terminal.

Observations were conducted by teams of two trained observers in all ISM schools during the month of May and the first week of June of 1978. School personnel were told that they would be visited twice during the five-week period, but were not given specific dates for the visits.

A total of 125 elementary classes (70 in first year schools and 55 second year) and 28 junior high classes (14 each first year and second year) were observed. Seventy-five (49%) of the classes in 21 schools utilized the computer terminal for ISM assessments.

In the 21 schools where students used the terminal, 250 computer assessments were observed. In addition, 302 individually administered paper-pencil/demonstration assessments were observed (199 in 42 sessions in first year schools, and 103 in 22 sessions in second year schools).

The data collected addressed a variety of aspects of ISM, including assessment, instructional practices, classroom management, use of reports, teacher training, and attitude toward the program.

In the present report, we have organized the findings by the component of ISM to which they most directly relate: instruction, assessment, or reporting. Although each of these areas is not, in fact, addressed with equal comprehensiveness, we feel this approach serves well to point out where ISM is functioning effectively and where modifications must be made.

# CHAPTER 2

# FINDINGS

## A. THE INSTRUCTIONAL COMPONENT

The instructional component of ISM is the heart of the system, providing teachers with both objectives and guidelines for teaching. The previous evaluation of the system (Seitz, 1977) found the basic components of instruction, the curriculum and instructional guides, to be extremely well received and useful. Teachers reported that the guides were easy to understand, provided helpful suggestions for teaching and resource use, and generally were considered an effective instructional support. The present evaluation, while looking only informally at these materials, verified that the curriculum and guides are considered to be extremely useful. In many cases, when teachers discussed what they liked about ISM, these aspects of the program were singled out.

The formal focus in the present evaluation of instruction was on the effects of ISM on the teaching process itself, both on preparation for instruction and on instructional management. Specifically, the evaluation examined the degree to which teaching was matched to individual student needs, and how satisfied teachers seemed to be with its effects. To supplement these data, a brief analysis has been made by the Department of Educational Accountability of Iowa Tests of Basic Skills scores to see how these instructional changes are reflected in achievement test measures.

1. Individualization

Several aspects of the instructional process were examined to determine whether or not ISM increased the degree to which instruction was individualized. In ISM, individualization is defined as instruction matched to individual student needs. Some indices of individualization examined in this study include time allocations for instructional preparation, grouping for instruction, content of instruction, and resource use.

Instructional Preparation:

First year teachers were asked to compare time required for planning and coordinating activities before and after the introduction of ISM. Table 4 presents their responses. The data clearly indicate that teachers feel they spend more time in planning with ISM than they did prior to its introduction. Especially large increases were reported in planning for individualized and small group instruction. It appears then, that the system is having its desired impact in increasing this aspect of teachers' attention to individual student needs.

The fact that overall planning time increased regardless of group size should not, however, be passed over without comment. Table 4 clearly shows that ISM brings overall increases in preparation demands for teachers in the first year schools. This finding is, of course, expected, when any new system is implemented and must be learned. However, reports of second year teachers suggest that they feel planning time remains a problem. Fifty-five percent of the teachers surveyed indicated that, in general, time for planning was as much or more of a problem in the second year as the first.

Table 4

Comparison for First Year Teachers in Amount of Time Spent in Preparation for Mathematics Instruction Before and After the Introduction of ISM

| | Much More or Somewhat More After Introduction of ISM[a] | About the Same After Introduction of ISM[a] | Less or Much Less After Introduction of ISM[a] |
|---|---|---|---|
| Organizing groups for instruction | 72% | 21% | 4% |
| Planning for individualized instruction | 74 | 21 | 3 |
| Planning for small group instruction | 67 | 28 | 2 |
| Planning instruction for the entire class | 50 | 37 | 10 |
| Long range planning | 41 | 35 | 11 |
| Organizing commercial materials for instruction | 54 | 36 | 7 |
| Preparing and organizing own materials for instruction | 69 | 24 | 4 |
| Coordinating activities with other teachers | 38 | 43 | 11 |
| Coordinating activities with the ISM aide | 68 | 10 | 2 |

[a]Indicates percent of sample selecting response category.

Since the question asked of second year teachers had no follow-up, it is not possible to determine why teachers saw the problem as persisting or exactly what it is about planning that poses difficulties. It may be that teachers have had insufficient training in how to prepare for small group and individual instruction and are not making the most efficient use of their own resources. It may also be that increasing the amount of individual/small group instruction in public education calls for a redefinition in the manner in which teachers allocate their time; and that the perceptions of increased burden really are a manifestation of the reluctance which workers in nearly all fields exhibit when required to adapt to an innovation or new responsibility inherent in performing their accustomed jobs. At this point, it can only be concluded that in the view of teachers, demands for increased preparation time persist and these demands are viewed as a problem.

Grouping for Instruction:

The evaluation looked at both instructional group size and flexibility of grouping practices. Perceptions of both principals and students were obtained.

Table 5 presents the responses of principals. The data show that the principals generally report that more time is spent in small group and individual instruction after the introduction of ISM than in previous years. This is reported by both elementary and junior high principals, although in the latter case the sample is clearly extremely small. Overall, 60% report an increase in small group instruction; 52% report increases in individualized instruction. However, this finding is at least partially challenged by student reports of

Table 5

Comparison by Principals of Changes in Classroom Organization and Use of Differing Instructional Grouping After the Introduction of ISM--Elementary

Elementary (N=25)

| | Very Much More Now | Somewhat More Now | About the Same Now | Somewhat Less Now | Very Much Less Now |
|---|---|---|---|---|---|
| Whole class instruction | 0 | 0 | 40 | 32 | 28 |
| Small group instruction (2-9 students) | 14 | 50 | 36 | 0 | 0 |
| Individualized instruction (1 student) | 14 | 36 | 50 | 0 | 0 |

Junior High (N=3)

| | Very Much More Now | Somewhat More Now | About the Same Now | Somewhat Less Now | Very Much Less Now |
|---|---|---|---|---|---|
| Whole class instruction | 0 | 0 | 0 | 0 | 0 |
| Small group instruction (2-9 students) | 0 | 100 | 0 | 0 | 0 |
| Individualized instruction (1 student) | 0 | 67 | 33 | 0 | 0 |

grouping practices in their classrooms. Of the total group of students surveyed, 53% reported that their whole class was considered a single group for mathematics instruction and no subgroups were formed. This practice was reported as more prevalent at the junior high than the elementary level. While 85% of the junior high school students reported that whole-class instruction was the only strategy employed, only 33% of students in Grades 4-6 said this was true in their classes. While these data do not refute the principals' claims of change after the introduction of ISM nor negate the possibility of some individualized attention within large groups, they do suggest that current grouping practices are not optimal, especially at the junior high school level. Further, because of differences in the wording of questions to principals and students, it may be that part of the inconsistency in responses is due to the inconsistency in the ways the questions were posed.[4]

Observational data indicate that both whole class and small group/individual instruction are occurring. In 53% of the classes, whole class instruction was observed; in 48%, small-groups were instructed; and in 51% of the classes, individual (one-to-one) instruction was observed.[5]

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[4] Principals were asked "Among the teaching staff as a whole, how much more or less is each of the following types of classroom organization being used now, as compared with years prior to the use of ISM in your school? - whole class instruction, small group instruction, individualized instruction." Students were asked "Is there more than one math group in your math class? How many different math groups are there in your math class?"

[5] Percentages do not total 100% since during some time periods more than one mode of instruction as observed.

Again, considerably more whole class instruction was observed at the junior high levels than at the elementary school levels.

Students were also asked how long they had been in their present math group. Of the students who reported that any instructional grouping was practiced in their classes, an overwhelming number, (78%) reported that they stayed in the same group all or most of the year.

Observers recorded the number of groups (of more than one student) actually receiving instruction during a class period. (This is not necessarily the total number of existing math groups in a class, since it was possible for one group to receive no direct instruction during a period; in addition, groups theoretically change from time to time depending upon subject matter being taught.) The number of groups ranged from none (approximately 9% of teachers gave no instruction during the class periods observed) to five. In the elementary schools, 51% had one group receiving instruction, 24% had two, 9% had three, 5% had four, and less than 1% (two classes) had five groups receiving instruction during the period. In comparison, 86% of the junior high classes had only one instructional group, while 7% had two and 4% had three. The main difference between first and second year schools in this regard was in the number of classes with only one instructional group: 51% in first year schools and 65% in second year.

Content of Instruction:

The number of different instructional categories and of objectives-within-instructional-categories being taught is another indication of flexibility of math instruction under ISM. Table 6 summarizes this information for the classrooms observed. In approximately 26% of the elementary classes and 43% of the junior high classes, work was being done in a single category. The percentage of classes working in two categories was approximately equal for elementary and junior high classes (27% and 29%, respectively). However, 46% of the elementary classes and only 11% of the junior high classes were working in more than two categories.

Numbers of objectives is perhaps a more easily interpretable indicator of degree of individualization, since all students may be working on one category (e.g., common fractions) but be at different levels within that category. In 15% of all the classes observed, all students were working on the same objective (14% elementary; 18% junior high). Two objectives were being worked on in 23% of elementary and 29% of junior high classes. Three objectives were being worked on in 22% of the elementary schools and 32% of the junior high classes. A greater difference was observed between the two types of schools in the number working on four or more objectives: 41% of the elementary, but 11% of the junior high classes were working on four or more objectives.

Table 6

Number of Categories and Objectives
Being Worked On In ISM Classes

Categories

| | Schools | | | | |
|---|---|---|---|---|---|
| | First Year Schools | Second Year Schools | Elementary | Junior High | Total |
| Number | N=84 | N=69 | N=125 | N=28 | N-153 |
| 1 | 33.3% | 24.6% | 26.4% | 42.8% | 29.4% |
| 2 | 26.2 | 29.0 | 27.2 | 28.6 | 27.4 |
| 3 | 14.3 | 26.1 | 21.6 | 10.7 | 19.6 |
| 4 | 11.9 | 5.8 | 11.2 | - | 9.2 |
| 5 | 4.8 | 7.2 | 7.2 | - | 5.9 |
| 6 | 1.2 | 1.4 | 1.6 | - | 1.3 |
| 7 | 2.4 | - | 1.6 | - | 1.3 |
| 8+ | 9.5 | 1.4 | 3.2 | - | 2.6 |
| N.A. | 2.4 | 4.3 | - | 17.8 | 3.3 |

Objectives

| | | | | | |
|---|---|---|---|---|---|
| 1 | 15.5% | 14.5% | 14.4% | - | 15.0% |
| 2 | 27.4 | 20.3 | 23.2 | 17.8 | 24.2 |
| 3 | 20.2 | 27.5 | 21.6 | 28.6 | 23.5 |
| 4 | 13.1 | 14.5 | 16.0 | 32.1 | 13.7 |
| 5 | 7.1 | 11.6 | 11.2 | 3.6 | 9.2 |
| 6 | 7.1 | 1.4 | 5.6 | - | 4.6 |
| 7 | 1.2 | 4.3 | 3.2 | - | 2.6 |
| 8+ | 8.3 | 1.4 | 4.8 | 7.1 | 5.2 |
| N.A. | - | 4.3 | - | 10.7 | 2.0 |

Resource Use:

A final indicator of the extent to which instruction is geared toward meeting individual student needs is the variety of materials available and used in the classroom. An especially important question is whether there is a greater emphasis on the use of manipulative materials, demonstrations, and "hands on" materials than there was before the introduction of ISM.

Principals were asked about both the availability of materials and their use before and after the introduction of ISM. Tables 7 and 8 present their responses. The data show that, both before and after the introduction of ISM, the principals generally felt that sufficient materials were available and that these materials were appropriately used. However, the responses suggest that there were some significant changes after introduction of the program, especially in the use of materials of all kinds.

Observations of ISM classes provided additional evidence concerning the range and extent of the use of various materials for mathematics instruction. Table 9 lists the materials and the percent of classes in which each type of material was observed in use. Clearly, the blackboard, textbook, and worksheet/workbook are very popular in the ISM classroom as in all classrooms. There was, however, significantly more use of a much wider range of materials within the elementary classes. Within the junior high classes, the range was more restricted, and the types of materials used were generally those which one would expect to find within the context of the traditional whole-class lecture type of instruction.

Table 7

Responses by Principals Relating to the Availability of Instructional Materials Before and After the Introduction of ISM

| | AVAILABILITY THIS YEAR | | | AVAILABILITY PRIOR TO ISM | | |
|---|---|---|---|---|---|---|
| | Always or Usually | Sometimes | Rarely or Never | Always or Usually | Sometimes | Rarely or Never |
| Measurement materials | 64 | 12 | 4 | 64 | 24 | 8 |
| Textbooks on or below the grade levels of the class/group | 92 | 8 | 0 | 92 | 0 | 4 |
| Textbooks above the grade level of the class/group | 84 | 16 | 0 | 80 | 8 | 8 |
| Graphing materials | 80 | 20 | 0 | 64 | 24 | 8 |
| Commercially made activity cards and/or kits | 76 | 20 | 4 | 56 | 28 | 12 |
| Commercially made manipulatives (base ten blocks, counting beads, etc.) | 64 | 32 | 4 | 40 | 28 | 28 |
| Commercially made workbooks, ditros | 64 | 24 | 12 | 60 | 24 | 12 |
| Non-print materials (Filmstrips, tapes) | 56 | 28 | 16 | 48 | 36 | 12 |
| Other | 0 | 0 | 0 | 0 | 0 | 0 |

Table 8

Perceptions of Principals Relating to the Use of Instructional Materials Before and After Introduction of ISM

| | THIS YEAR | | | PRIOR TO ISM | | |
|---|---|---|---|---|---|---|
| | More or Much More Often Than Appropriate | Appropriate | Less or Much Less Often Than Appropriate | More or Much More Often Than Appropriate | Appropriate | Less or Much Less Often Than Appropriate |
| Measurement materials | 0 | 92 | 4 | 0 | 48 | 44 |
| Textbooks on or below the grade level of the class/group | 0 | 92 | 4 | 8 | 68 | 16 |
| Textbooks above the grade level of the class/group | 0 | 84 | 12 | 8 | 60 | 24 |
| Graphing materials | 0 | 80 | 16 | 0 | 40 | 52 |
| Commercially made activity cards and/or kits | 0 | 72 | 26 | 0 | 48 | 44 |
| Commercially made manipulatives (base ten blocks, counting beads, etc.) | 0 | 88 | 8 | 0 | 32 | 60 |
| Workbooks or dittos | 12 | 80 | 4 | 20 | 60 | 12 |
| Non-print materials (Filmstrips, tapes) | 0 | 80 | 16 | 0 | 68 | 24 |
| Other | 0 | 0 | 0 | 0 | 0 | 0 |

Table 9

Percent of Classrooms Observed Using Listed Materials for Math Instruction

| | Elementary Classes (N=125) | Junior High Classes (N=28) | Total Classes (N=153) |
|---|---|---|---|
| Blackboard | 69.6% | 75.0% | 70.1% |
| Overhead Projector | .1 | 25.0 | 5.8 |
| Slide/Filmstrip | 3.2 | - | 2.6 |
| Worksheet/Book | 70.4 | 46.4 | 65.6 |
| Textbook | 46.4 | 39.3 | 44.8 |
| Calculator | 1.6 | - | 3.9 |
| Record/Tape | 1.6 | - | 1.3 |
| Learning Center | 4.8 | - | 3.9 |
| Manipulatives | 48.0 | 10.7 | 40.9 |
| Games | 10.4 | - | 9.1 |
| Kits | 4.8 | - | 3.9 |
| Activity Cards | 2.4 | - | 1.9 |
| Teacher-Made Materials | 13.6 | 7.1 | 12.3 |
| Television | .1 | 10.7 | 2.6 |
| CAI (Math-Arithmetic) | .1 | - | .6 |

Individualization: Summary

The data indicate that after the introduction of ISM, teachers spend more time in instructional planning, especially for individuals and small groups of students. Examination of classroom practices indicates that this planning does result in many cases in instruction which appears to match individual student needs. However, in many classes instructional practices appear unaffected and individualization is not being achieved. Whole group instruction, unchanging grouping, and undifferentiated instructional content are reported. Consistently, such problems are greater at the junior high than the elementary levels. There clearly is a long way to go in clarifying what it means to individualize instruction and in assisting teachers to effectively implement the individualized approach.

Individualization: Recommendations

If ISM is to realize its potential, a far greater emphasis must be placed on individualization of instruction within the system. The basic assumption underlying the use of a system of computer managed instruction is that computers are more efficient than manual methods of keeping track of the progress being made by individual students working in different segments of a course at different rates of progress. If instruction is not in fact being affected by such data, then the use of the computer ceases to be an educational benefit.

Given the fact that an important objective underlying the implementation of ISM was to increase individualization of instruction, the answer appears to be to place renewed emphasis on helping teachers understand and implement individualized techniques. We suggest that the best means of doing this are the following:

- Make it clear to teachers, principals, and specialists especially in the junior high schools, that individualization of instruction is important to the success of the children in the program. Instruct principals that in their monitoring of ISM they should look for and support behavior which contributes to individualization and its goals.
- Offer sufficient inservice training opportunities in the individualization of math instruction to ensure that all teachers have the opportunity to develop the required skills and that all principals are qualified to assess the efficacy of the individualized instructional activities in ISM schools.
- Examine the problems related to time for instructional preparation and assist teachers in decreasing the burden it imposes.
- Require that the Department of Instructional Planning set forth objectives for observed individualization of ISM instruction at both the junior high school and elementary levels; develop a plan for conducting formative evaluations of the progress made in meeting these objectives at each ISM school; and report annually on the results of their formative evaluation activities. Under such a plan, the goal for this year might be that 80% of elementary instruction and 50% of junior high

*school instruction might be observed as being individualized (using number of groups, number of objectives being worked on, etc. as criteria); that the percentages increase to 85% and 70% next year; and that they be 90% and 90% thereafter.*

- *Hold the Department of Educational Accountability responsible for periodically conducting its own evaluations of individualization and report its findings to the superintendent.*

2. Attitudes Toward Mathematics

The 1977-78 survey asked principals, teachers and aides what they felt the impact of ISM was on attitudes toward mathematics. Consistently, it was reported that the instructional component was having a positive effect. Much of this effect was attributed to the content and structure of the basic curriculum materials and guides. Of the teachers surveyed, 62% reported that ISM contributed to the comprehensiveness and thoroughness of the mathematics curriculum, 66% reported that it has increased the consistency of the curriculum across grade levels, and 68% indicated that ISM contributed greatly to the information available to them. Some concern, however, was expressed by about 45% of second year elementary school teachers that the system resulted in over-emphasis on mathematics at the expense of other subjects.

Principals also reported a number of positive impacts. Eighty percent said they felt that the school was more effective in teaching mathematics; 72% said that students' self-confidence and ability had improved, and 76% reported an increased ability to communicate with parents regarding student progress. The reports of aides were consistent with these findings.

*Attitudes Towards Mathematics: Summary*

*In general, there is agreement that the instructional system is liked and perceived as beneficial.*

*Attitudes Towards Mathematics: Recommendations*

*The content of the instructional system appears to be sound and satisfactory to teachers and administrators. There is no reason why expansion of this component of the system to additional schools should not be continued.*

3. Impact on Achievement

In order to gain some idea of the impact on achievement test performance of ISM participation, an analysis of changes in performance on the mathematics portion of the Iowa Tests of Basic Skills was conducted for a limited sample of elementary school students. The analysis examined changes in scores on the Mathematics Concepts and Problem Solving portions of the Iowa Tests of Basic Skills for a longitudinal sample of students who were in the third grade in 1976 and in fifth grade in 1978. The purpose of the analysis was to get a rough idea of how scores of students with one or two years of ISM experience compared with those for the county overall.[6, 7]

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[6] This analysis is labeled as "rough" both because no factors other than ISM participation were controlled and because the question on the ITBS and objectives at the ISM are not completely matched.

[7] It should be noted that scores for the overall county include the ISM schools. However, since these schools account for only 20% of the county sample, their impact on the county average is relatively small and probably unlikely to affect the conclusions drawn.

Table 10 presents these comparisons. The findings appear quite interesting. First of all, students whose schools were in that first year of ISM participation at the time of 1978 ITBS testing appear to be doing worse than students overall. Second, schools in their second year of ISM consistently scored higher than those schools in their first year. And third, schools in their second year of ISM participation performed better than the county as a whole on one subtest, Problem Solving, and worse on the other, Mathematics Concepts.

The fact that first year ISM schools do more poorly than others is expected. During the first year of any program, instruction and learning frequently are less effective because of the many problems presented by adapting to a new approach. However, the fact that second year schools show substantial improvement is extremely encouraging, especially in light of the fact that their students were initially considered to be among the lowest achievers. Further, their superior performance in problem solving is especially interesting and needs to be further explored.

Table 10

Longitudinal Change in ITBS Test Scores for Elementary School Students in Three Kinds of Schools: (1) All Schools, (2) First Year ISM Schools, and (3) Second Year ISM Schools

| | Change 1976-78 ITBS Math Concepts | Change 1976-78 Math Problem-Solving | N (students) |
|---|---|---|---|
| All Schools (Longitudinal only) | +3.43* | -2.70 | 4,671 |
| Schools in First Year of ISM | -1.587 | -4.33 | 493 |
| Schools in Second Year of ISM | 0.08 | -1.94 | 592 |

*presented in normal curve equivalents.

*Impact on Achievement: Summary*

*Overall then, the achievement test findings provide limited, but nonetheless real evidence that ISM, once established, can aid mathematics achievement. Based on this history of similar programs, we would expect analyses in future years to show that as schools gain increased experience with the system, test scores will surpass the present county averages. The pattern of change for first and second year schools is encouraging and should be interpreted as supporting an attitude of cautious optimism toward ISM's potential.*

*Impact on Achievement: Recommendations*

*Given the facts that the reported data were from a small sample of schools, that we were not able to analyze the degree to which the ISM schools outscored, or were outscored by, non-ISM schools in previous years, and that an erosion in scores during the early years of a significant innovation is both common and expected, we are not concerned about the test score pattern.*

*It should be expected that test scores will show improvement with increased years in the system, especially if the problems relating to individualization and assessment can be corrected in a timely manner.*

*We would emphatically state that the test scores reported in this section do not support an argument to curtail use of the system or contain it to the present set of schools.*

B. THE ASSESSMENT COMPONENT

The 1977-78 evaluation of ISM focused on one aspect of the assessment component: mastery testing. As stated earlier, mastery tests are criterion-referenced tests, intended to provide information on the progress of individual students. In essence, their purpose is to provide data on whether or not a student has mastered a given objective and can go on to a higher level objective; or has failed to master it and, therefore, needs more instruction. The tests do not indicate why failure has occurred or exactly what steps a teacher should take next, but rather whether learning is incomplete. ISM developers, while not being overly prescriptive, have offered the following guidelines for mastery testing:

(1) Assessments should be given at least a week after a student has completed instruction on an objective.

(2) Assessment should generally be conducted as an individual activity.

(3) Assessment should cover one or two objectives within a category at a single testing time.

(4) Reassessment should take place after a reasonable length of time has been provided for additional instruction.

Results of the evaluation for each of these dimensions is presented below.

Time of Test Administration

Teachers were asked to indicate the time elapsed between completion of instruction on an objective and mastery testing. Table 11 presents the responses

Table 11

Length of Time Elapsed Between Completing Instruction on an Objective and Mastery Testing

Teacher Reports

| | All Teachers | Teachers K-3 | Teachers 4-6 | Teachers 7-8 |
|---|---|---|---|---|
| One day | 4 | 1 | 3 | 20 |
| Two or three | 17 | 14 | 21 | 31 |
| One week | 34 | 33 | 38 | 28 |
| Two weeks | 25 | 28 | 26 | 8 |
| More than two weeks | 15 | 19 | 9 | 5 |

Overall, the data indicate that teachers generally are following the mastery test administration schedule recommended by the program developers. This is, 74% of teachers responded that they allowed at least a week to pass before mastery testing. Only at the junior high level does there appear to be substantial deviation from 51% of the teachers reporting an elapsed time of less than one week.

However, it should be noted that the notion of waiting at least a week can be considered to be highly suspect, given the rationale for computer managed instruction. A primary strength of CMI is that it permits the teacher to receive timely feedback as to where each student is located at any given point in time on an instructional continuum. By first delaying assessment for a week, and the providing only biweekly progress reports, the assessment component is ensuring that the data teachers are receiving data from one to three weeks out-of-date. This severely reduces the potential of the system as a classroom management tool and may be one of the key factors causing teachers to maintain redundant manual systems of collecting progress data.

Group Size for Mastery Testing:

There are two general types of mastery assessments: demonstration assessments and paper and pencil/computer assessments. All demonstration objectives are to be administered on a one-to-one basis. Paper and pencil assessments are also to be given in a one-to-one setting, although here there is greater flexibility and small group testing is sometimes appropriate. Computer assessment must be given to one child at a time.

The evaluation asked teachers to indicate the group size used for mastery testing. The data indicate that when teachers administer mastery tests, a substantial number report group testing. The majority of teachers (56%) in Grades K-3, and a considerable proportion (37%) of those in Grades 4-6 reported assessing groups on the same objective simultaneously. In addition, 41% of the junior high teachers reported that they frequently assessed an entire class at the same time.

However, the same question asked of aides rather than teachers elicited a different response. The ISM aides reported that assessment was conducted on a more individualized basis: 72% said they tested individually for demonstrations (generally in Grades K-3); and 60% reported small group testing for paper-pencil assessments, For computer administered assessments, individual assessment was reported by 45% of the respondents and small group assessment by 35%.[8]

The apparent contradiction in responses of teachers and aides requires some further examination. One explanation which receives some support from the reports of observers is that both teachers and aides administered mastery tests, but did so to groups of different sizes. For example, if a teacher felt that all his/her students were ready to be tested on a given objective he/she might test the whole group at once rather than sending individuals to the aide. Such use of group testing by teachers should not be

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[8] The reported use of small groups for computer administered testing is somewhat puzzling as technically only a single child can operate a terminal at a given time. Either the assessment process is being erroneously implemented or the survey question was badly misunderstood.

considered surprising given the relatively low level of individualization of instruction. However, in this area, as well as in the delivery of individualized instruction, the system is functioning somewhat differently from the manner intended.

Multiple Objective Assessment:

According to program developers, mastery tests are distributed across the curriculum in such a way as to make it unlikely that a student would be ready for assessment on more than one objective in a single category. Teachers and aides were queried as to whether one or more objectives typically were covered in a single test session. Teachers responses indicated that multiple objectives are assessed in many instances and that the practice seems to be more prevalent in computer schools than in pencil/paper schools. Sixty percent of teachers in non-computer schools or classes reported testing students on only one objective per sitting, while slightly fewer (49%) of the teachers in computer-assisted schools reported adhering to this practice. Because the questionnaire items did not distinguish between objectives which were within and across categories the implications of these reports are difficult to assess.

The responses of aides generally confirmed this pattern. Sixty-three percent said that all or most students took more than one paper-and-pencil assessment at a time, and 75% said that all or most had taken more than one assessment at the computer terminal at one sitting.

Observers also reported that it was common practice for students to take multiple assessments, both at the computer terminal and with the ISM aide and according to observers, multiple assessment within single categories was noted. It was estimated that over half

the students either passed one assessment and attempted another one in the same category, or attempted assessments in more than one category.

Clearly attempting assessments in several categories is quite different from attempting sequential objectives within a single category. A child may, for instance, be instructed to attempt an objective in division and a different, but related, objective in ratio and proportion. Such objectives might be taught simultaneously and, hence, simultaneous assessment would be appropriate. On the other hand, several aides reported that some teachers appeared to use the assessment process as a diagnostic tool, instructing a student to continue attempts in a category until he or she failed to master an objective.

Confirmation of this practice arises from observers' estimates of students' preparedness for assessment. Observers were instructed to indicate when they judged a student clearly did not "have the knowledge necessary for working the assesment problems." In 17% of the computer assessments and 22% of the aide administered assessments students were judged not prepared.

If teachers are attempting to use the mastery tests as a diagnostic tool, a question is raised regarding whether existing placement tests fully meet instructional needs. A careful look needs to be taken at these placement tests to ascertain whether their content and frequency provide the most cost-effective means of assisting teachers in the diagnostic process.

Reassessment

When a student fails to master a particular objective, additional instruction on that concept and reassessment on another form of the mastery test are supposed to occur. In examining ISM, it is, therefore, important to look at the timing between failure to demonstrate mastery, and reassessment, as well as what occurred during the time interval.

Teachers were asked to indicate the length of time which usually elapsed between assessment and reassessment. A substantial majority, 87%, reported that they allowed at least a week to pass before reassessment. Of this 87%, 31% reassessed students after 1 week, 24% after 2 weeks, and 23% after more than 2 weeks. Only a small number reported conducting reassessment one day after the failed attempt, a practice which seems to allow little time for additional instruction. Unfortunately, the survey did not include adequate questions about activities during the test-retest interval. Assessing whether or not a one week, two week, or greater time lapse is appropriate is, therefore, not possible. Logically, however, one might question whether or not a delay of more than two weeks might not be excessive.

Problems in Assessment

Several problems in managing the assessment process merit consideration here. Of special concern were:

(1) aides' management of time and their ability to meet assessment schedules;

(2) ISM design requirements permitting results to be entered into the computer in a fixed order only, within a single category;

(3) interruptions of instruction by the assessment process; and

(4) problems of test security.

ISM aides report that they cannot keep abreast of the demand for assessments. Fifty percent reported that there are days when they cannot administer all the demonstration assessments requested. Thirty percent had a similar problem in attempting to administer and score paper-pencil tests, and 20% said they cannot give all of the required computer assessments. These reports were confirmed by teachers and principals, who say that aides cannot administer and score mastery tests within reasonable time limits even though the aides often take tests home for scoring. The constructed response format appears to contribute substantially to this problem as many available time-saving aids to scoring, such as special scoring keys or optical scanning systems, cannot be used.

It is important to consider these findings in light of the previously reported data regarding the size of the group tested and the observations regarding testing of multiple objectives within categories. It clearly seems that aides cannot meet current demands for assessment and are deviating from program guidelines in order to administer the maximum number of tests to the largest number of students. Whether, under such conditions, the assessment component is functioning efficiently and effectively seems seriously in doubt. Even within the time frame for testing recommended by the program--testing no earlier than one week after instruction--it is difficult to see how the mastery tests function as management supports. However, the picture which emerges suggests that delays are frequently longer and testing procedures often deviate from recommended practice.

The breakdown in the system resulting from the assessment load clearly needs detailed future investigation, since it is undoubtedly contributing to the growth of redundant manual systems for recording progress and to delays which are hampering instruction.

The second problem mentioned is more technical in nature, and, although it is considered separately, it relates to the issues discussed above and to the problems confronting aides' management of their time. The present ISM design demand that assessments at the terminal, and the results of paper-pencil assessments, be entered into the computer in given hierarchical order. The system was deliberately structured in this fashion at the insistence of the program developers who believe in the sequential nature of mathematics instruction. Experience has shown, however, that students do not necessarily master objectives in the order of hierarchy. For example, a study may fail to master Subtraction Objective 1 (SU-1) on a paper-pencil test, but master SU-2 if given that test. Mastery of SU-2 cannot, however, be entered into the student's computer record because SU-1 has not been mastered. If the student were to take the mastery test at the computer terminal, it would not even be possible to discover that he/she can master SU-2 (unless the aide administered a paper-pencil version of SU-2). Failure to master SU-1 would, in effect, "block" the computer, and the student could not obtain access to an SU-2 mastery test--even though the student could actually master the higher-level objective.

This limitation, according to staff members, has two unfortunate effects. A comment made uniformly by the aides was that the restriction has either stifled students' progress or seriously interfered

with the accurate monitoring of progress. In order to cope, teachers and aides bypass the system. They assess students on higher-level objectives when they believe students can master them, and keep complex records by hand. The system thus also creates a somewhat competitive sub-system which clearly places additional burdens on staff.

It should be noted that the reason for this unnecessary restriction is a facet of the instructional design, not the computer system. While this type of restriction can possibly be justified in a computer assisted instructional system (although many instructional technologists would argue this point), in a computer managed instructional system, it cannot be justified under any circumstances; and it is a prime example of permitting machine restrictions to act adversely on human behavior. Given the ample evidence that the restriction is leading to redundant manual record keeping and is hindering progress. It should be removed at the earliest possible date. This will probably entail a significant computer programming expense, but the implications of the present restriction are such that they cannot be tolerated.

The third problem, one reported primarily by teachers, is the interruption of mathematics classes by the assessment process; and, to a lesser extent, the interruption of other classes as well. Tables 12 and 13 show proportions of teachers who reported the problem in the 1977-78 survey.

Table 12

Frequency and Type of Interruptions of Math Classes: Teacher Report

| | ALL TEACHERS | | | | | TEACHERS K-3 | | | | | TEACHERS 4-6 | | | | | TEACHERS 7-8 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Almost Daily | Once or Twice a Week | Biweekly | Once a month | Hardly ever or never | Almost Daily | Once or Twice a Week | Biweekly | Once a month | Hardly ever or never | Almost Daily | Once or Twice a Week | Biweekly | Once a month | Hardly ever or never | Almost Daily | Once or Twice a Week | Biweekly | Once a month | Hardly ever or never |
| Movement of the students being assessed | 13[a] | 28 | 14 | 8 | 32 | 5 | 24 | 19 | 11 | 36 | 23 | 32 | 8 | 5 | 27 | 16 | 23 | 15 | 4 | 38 |
| Use of the Computer Terminal in the Classroom | 4 | 6 | 2 | 1 | 57 | 0 | 8 | 8 | 0 | 69 | 17 | 21 | 0 | 2 | 43 | 0 | 13 | 19 | 0 | 63 |
| Necessity of Teacher help with assessments | 14 | 24 | 12 | 9 | 34 | 8 | 21 | 13 | 12 | 35 | 20 | 37 | 6 | 7 | 26 | 19 | 12 | 15 | 0 | 50 |
| Management of the flow of students to the computer terminal or the aide | 7 | 19 | 13 | 9 | 36 | 8 | 0 | 15 | 8 | 54 | 21 | 40 | 9 | 6 | 17 | 7 | 19 | 23 | 0 | 46 |
| Malfunction of the computer terminal | 1 | 4 | 4 | 9 | 51 | 0 | 0 | 8 | 8 | 62 | 4 | 19 | 9 | 28 | 36 | 0 | 0 | 25 | 25 | 44 |
| Removal of students from the class for assessments | 8 | 26 | 17 | 13 | 29 | 2 | 22 | 20 | 13 | 35 | 14 | 33 | 12 | 13 | 23 | 12 | 27 | 27 | 4 | 27 |
| Other(specify) | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 |

a. percent of respondents choosing each category

Table 13

Frequency and Type of Interruption of Classes Other Than Mathematics: Teacher Report

| | ALL TEACHERS | | | | | TEACHERS K-3 | | | | | TEACHERS 4-6 | | | | | TEACHERS 7-8 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Almost Daily | Once or Twice a Week | Biweekly | Once a month | Hardly ever or never | Almost Daily | Once or Twice a Week | Biweekly | Once a month | Hardly ever or never | Almost Daily | Once or Twice a Week | Biweekly | Once a month | Hardly ever or never | Almost Daily | Once or Twice a Week | Biweekly | Once a month | Hardly ever or never |
| Movement of the students being assessed | 9[a] | 15 | 10 | 13 | 37 | 4 | 16 | 20 | 20 | 34 | 19 | 21 | 4 | 10 | 33 | 5 | 0 | 0 | 0 | 55 |
| Use of the Computer Terminal in the Classroom | 4 | 4 | 0 | 1 | 54 | 8 | 8 | 0 | 0 | 46 | 17 | 17 | 0 | 2 | 40 | 0 | 0 | 0 | 0 | 47 |
| Necessity of Teacher help with assessments | 5 | 12 | 4 | 7 | 48 | 2 | 8 | 6 | 9 | 55 | 10 | 21 | 0 | 6 | 43 | 9 | 0 | 0 | 0 | 50 |
| Management of the flow of students to the computer terminal or the aide | 4 | 14 | 5 | 9 | 42 | 0 | 15 | 8 | 15 | 23 | 19 | 30 | 4 | 11 | 21 | 0 | 5 | 0 | 0 | 50 |
| Malfunction of the computer terminal | 1 | 3 | 1 | 5 | 51 | 0 | 8 | 0 | 8 | 46 | 4 | 13 | 4 | 21 | 40 | 0 | 0 | 0 | 0 | 63 |
| Removal of students from the class for assessments | 6 | 15 | 10 | 14 | 36 | 2 | 17 | 14 | 21 | 35 | 15 | 20 | 8 | 10 | 30 | 0 | 5 | 0 | 0 | 54 |
| Other(specify) | 0 | 1 | 1 | 0 | 2 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 2 | 0 | 4 | 0 | 0 | 0 | 0 | 4 |

a. percent of respondents choosing each category.

According to the survey, in order of importance, teachers felt that interruptions resulted from the movement of students, the need for teachers to help with assessments, and the removal of students from class. Such interruptions are most frequent in Grades 4-6.

However, observer ratings suggest that the effect on instruction of these activities is not great and that the problem may be overstated. During 13% of the classroom observations, students missed instruction to go for assessment. This occurred in approximately 10% of the elementary and 25% of the junior high classes. Observer ratings of the extent to which interruption for assessment (either sending students out or allowing in-class assessment) was disruptive suggested, however, that such interruptions were, by and large, not severe (Table 14). While teachers might find these interruptions annoying, observers reported that disturbance to instruction of others was "very little" in approximately 74% of the cases and disturbance to seatwork was "very little" in 78% of the cases. With one exception, the remaining cases were judged to be of either "little" or "some" disturbance.

Table 14

Ratings by Observers of Disruption Caused
By Students Learning to Take Assessments

| | Interruption to Instruction of Others | | Interruption to Seat Work of Others | |
|---|---|---|---|---|
| | N | % | N | % |
| Very little | 40 | 74.1 | 42 | 77.8 |
| Little | 8 | 14.8 | 9 | 16.7 |
| Some | 5 | 9.2 | 3 | 5.6 |
| Much | 1 | 1.8 | 0 | 0 |
| Very Much | 0 | 0 | 0 | 0 |
| Total | 54 | 99.9 | 54 | 100.1 |

The extent to which assessments interrupted other subject-matter classes varied with school, class organization, and grade. In the junior high schools, mathematics is taught as a separate subject during an assigned period, as are other subjects. It is unlikely that students would be released from English, for example, to be assessed in mathematics. Consequently, teachers in Grades 7-8 reported that though the mathematics class might be interupted by the assessment process, other classes were not affected. In the elementary schools, where a given teacher may be responsible for one class all or most of the day, the situation is different. It is possible to send a student for assessment in mathematics when the rest of the class is working on another subject. This does, in fact, occur and it happens more frequently in Grades 4-6 than in K-3.

In the previous evaluation, teachers reported that the continuity of instruction was adversely affected by these interuptions, and that asking that students be released from other classes (or releasing them for a subject) had a mild to strong negative effect on staff relations. It does not appear that the same interpretation can be made of the current responses, but it does seem fair to assume that the mechanics of assessment probably do interfere with the contunuity of instruction to some extent now as in the past.

Finally, although not mentioned by study participants, questions were raised by observers regarding test security and whether or not adequate supervision was provided.

The observers reported that the responsibility for supervision of the terminal was most often assumed by the classroom teacher (33% of the cases) or by an ISM or math aide (39% of the cases), though in a few cases other school-based personnel were responsible. In almost 20% of the observed assessments, no one was clearly responsible for supervising the process.

In addition, when an individual was technically responsible for the supervision of the terminal, this person was often not immediately available to the student being assessed (for example, the aide might leave the room). In approximately one-third of the 250 assessments observed, students were actually unsupervised. This was more often observed in second year (38%) than in the first year (26%) schools.

Lack of supervision puts at risk the security of the assessments. In many of the settings observed, students being assessed were able to communicate with other students. In 4% of the 250 terminal assessments, students being assessed were coached by other students. (Coaching was defined as giving information which caused the student to alter an existing answer.) However, it should be noted that lack of supervision is not the only threat to security; it was observed that in 9% of the assessments a teacher or aide coached the student.

The Assessment Component: Summary

The 1977-78 evaluation of the assessment process in ISM indicates that this component is not functioning as it should, and that many aspects of it require significant modifications. Preestablished procedures relating to group size for testing and use of multiple assessments are not being followed. Where prescriptions are followed (lapse of time between instruction, and assessment, and between assessment and reassessment) it is not clear that teacher and student needs are, in fact, being met; and it is evident that some assessment procedures need to be reconsidered.

In addition, it is abundantly clear that the present assessment system is causing as many problems as it is solving. The backups and delays caused by manual scoring, and by managing, assessments are hindering progress and causing the growth of redundant manual systems. The sequencing restrictions inherent in the design are limiting the instructional options of both teachers and students, and further contributing to the use of what-should-be-unnecessary manual record keeping procedures.

Overall, one gets the impression that the assessment process is not presently functioning as a synchronized support to the mathematics curriculum but instead is, at best, running in parallel to it. Teachers, especially in schools without terminals, were found to keep their own records on student progress since testing. Consequently, test result reporting falls far behind school instruction. There is apparently too heavy a load for aides to handle adequately and the computer support system as presently designed does not relieve their difficulties. Problems with the computer input and feedback

have resulted in an assessment component which appears to be malfunctioning and counter productive. As with the instructional component, difficulties are especially apparent at the junior high level where school and class organization probably contribute to the difficulty of effective implementation.

The Assessment Component: Recommendations

The problems discussed above are especially critical to the success of ISM because a strong case can be made that an assessment component is the most crucial component of an instructional management system; and that if the assessment is ineffective, one is left with nothing more than a curriculum package that may, or may not be, implemented in the manner in which the designers intended.

In the case of ISM, we have gathered ample evidence that not only is the assessment component functioning ineffectively, but that it is suffering from a limited number of design flaws which appear to be counter productive to sound instructional practice.

Further, many questions have been raised regarding the structure and adequacy of tests currently being used. Of central concern is their constructed response format and the scoring burden it imposes. It is also unclear whether the alternative forms of tests which are used interchangeably are, in fact, measuring the same things. Finally, the use of mastery tests for diagnosis suggests that some modification in placement tests, their content and frequency might be needed.

Given these facts, it is especially impressive that the overall system is perceived as positively as teacher and administrator input indicates. One can only speculate about the level of support and the instructional gains which should be demonstrated when the flaws in this most critical instructional component are corrected. In addition, we feel that another problem is that all the issues which need to be addressed in redesigning the assessment component were not addressed in this, or the previous, study. For example, we have no evidence as to whether the computer terminal method of conducting assessments is more or less effective than the paper-and-pencil method; we have no idea as to which method is less costly; we have no evidence that the instructional value of constructed responses is superior to that of forced choice responses; and we have no evidence that using the aides for scoring and/or for data input is more effective than would be centralized scoring and data entry. All of these types of issues should be addressed before any redesign of the assessment component is finalized.

Given these considerations, we recommend the following:

- Until mechanisms for increasing the flexibility of the assessment component and relieving the input "gluts" are put into place, no further expansion of the assessment component should be permitted, and no new computer terminal schools should be added, even where currently planned for January of 1978. Thus, while findings provided earlier in this report strongly support the further expansion of the instructional component of the system, we feel that the new schools should <u>only</u> implement the instructional component until repairs can be made on the assessment component. We also suggest that this will permit a far smoother expansion of ISM, since the teacher specialists will be able to concentrate upon supporting the use of the instructional guides and instructional objectives, and increasing the use of individualized and small group instruction, rather than having to train

teachers and aides in the use of the assessment component. We suggest that until most of the problems with the assessment component are repaired, teachers in the new schools merely be provided with the assessment materials and encouraged to use them and keep their own informal records. Since this is largely what is being done in the present set of ISM schools, we do not view this as working a particular hardship on the new teachers.

- o The superintendent should place the highest priority on redesigning and reconstructing the assessment component with the objective of having a modified assessment system in place by September, 1979, and a finalized version available a year later. We would suggest that the schools added to the system in January, 1979 become the pilot group for implementing the September, 1979 version; and that the remaining new schools, plus the schools now using the automated assessment components be brought over to the new assessment system in September, 1980.
- o By January, 1979, some possible variations in assessment procedures should be established in the present set of automated schools on a pilot basis so that the effects can be evaluated in the Department of Educational Accountability's study this spring. Of particular importance is exploring the feasibility of using forced choice assessment instruments and machine scoring on optical mark forms. Of secondary importance is determining whether centralized scoring and processing of assessment measures in paper-and-pencil schools and in the lower grades in terminal schools is more efficient and cost-effective than is having each school do its own processing.
- o Formative evaluation of the assessment tests themselves should be conducted. This evaluation should include, but not be limited to, an examination of the equivalence of alternative test forms; and an analysis of the adequacy of the placement tests.

- With the exception of the planned variations described above, schools now using automated assessment procedures--whether terminal driven or paper-and-pencil--should continue to do so in the manner to which they have become accustomed; except that as components of the redesign effort become available, they be installed as quickly as possible.

C. THE COMPUTER REPORTING COMPONENT

The survey collected data from both principals and teachers on their use of the three reports produced by the computer, the Class Profile, the Monthly Report, and the Student Profile.

Table 15 shows the response of principals to questions regarding their use of reports. With one exception, little differentiation is made among the documents and all are reported as being used for the same purpose. Among the alternative uses presented, by far the most popular choice for principals was long range planning, with all three reports being used for this purpose. Only for parent conferences did the use of reports appear to differ, with the Student Profile being the major resource document.

Program developers feel that the reports are intended mainly for teachers and that the main role of principals is to receive, perhaps review, and then distribute them to the teaching staff. Table 15 clearly shows that principals do not, in fact, make much use of the reports. Approximately 60% of the principals reported never using any of the reports for assigning students to classes, reallocating aides to specific groups of students or teachers, or distributing or reallocating material resources. The only areas besides long range planning selected with any frequency by the principals was "identification of areas in which in-service training is needed."

Table 16 presents data on the use of reports by teachers. The data indicate that the teachers use all three types of reports with much greater frequency than principals. Like principals, however, teachers use the three reports in similar ways. Again, as among principals,

the only exception to this pattern is for parent conferences, where the Student Profile is the major report used.

Examination of the frequency of use of each report revealed few significant or interpretable findings. Further, monthly reports were found to be used only slightly less frequently than reports produced more often. Only for the questions regarding the assignment of students to groups did response patterns show much differentiation. Here, there was a tendency to use two reports, the class profile and the individual student profile, on a weekly basis. In all other cases, responses about frequency of use were distributed rather evenly across possible categories, and no meaningful patterns emerged.

Table 16

Frequency of Use of Computer Reports: Teacher Response

| | CLASS PROFILE | | | | | INDIVIDUAL STUDENT PROFILE | | | | | MONTHLY REPORT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | At Least Weekly | At Least Biweekly | At Least Monthly | Every Marking Period | Never | At Least Weekly | At Least Biweekly | At Least Monthly | Every Marking Period | Never | At Least Weekly | At Least Biweekly | At Least Monthly | Every Marking Period | Never |
| Assignments of Students to Groups | 30[a] | 17 | 21 | 4 | 19 | 18 | 11 | 19 | 8 | 35 | 15 | 8 | 32 | 5 | 30 |
| Assignments of Grades or Working Levels | 18 | 12 | 14 | 21 | 23 | 15 | 8 | 16 | 23 | 25 | 7 | 5 | 21 | 16 | 35 |
| Parent Conferences | 4 | 2 | 6 | 27 | 47 | 3 | 2 | 7 | 49 | 26 | 1 | 2 | 7 | 20 | 52 |
| Identification of Problem Solving Levels for Individual Students | 11 | 8 | 29 | 9 | 31 | 9 | 8 | 23 | 13 | 34 | 5 | 5 | 40 | 9 | 24 |
| Long-range Planning | 19 | 16 | 29 | 14 | 13 | 11 | 12 | 23 | 12 | 31 | 8 | 9 | 33 | 12 | 24 |
| Other (specify) | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 4 | 0 | 1 | 2 | 0 | 4 |

[a]Percent of respondents selecting each category

The Computer Reporting Component: Summary

The three types of reports produced by the computer are intended to serve different functions. However, teachers and principals appear to be using (or not using) them in quite similar ways. This finding suggests several interpretations. First, it is not clear that school staff understand how to use the reports to the greatest advantage. Second, they may understand how to use them but, for some reason, fail to apply this knowledge. Thrid, the reports may not, in fact, provide useful information.

The Computer Reporting Component: Recommendations

The fact that differential reports are not provided to principals and teachers immediately makes the efficiency of the reporting component suspect. One would expect that principals need summary and trend data provided in a concise manner at either the class or grade level of reporting. They should not be receiving reports at the student level of reporting.

Another indicator that some revisions are probably called for is the fact that both teachers and principals report using the different kinds of reports for essentially the same purposes. This suggests that the reports should be redesigned so as to reduce their number and permit the needed planning data to be obtained from a single source for teachers and a single source for principals. The development of reports which can serve the purposes for which none of the present reports are being used is probably also indicated.

Finally, some attention has to be given to the issue of frequency of publication. Depending upon the format and purposes of a given report, it might

best be provided more frequently than is presently the case, or less frequently. As reports are developed to serve different needs, the issue of frequency should be examined carefully, since this has significant affects on the redesign of the assessment component.

## D. SUMMARY OF FINDINGS

Of the three components of ISM--the instructional component, the assessment component, and the computerized reporting component--only the instructional component appears to be functioning in a highly effective manner.

Teachers and principals like the curriculum and instructional guides and find them helpful and useful. In addition, progress has been made--especially at the elementary grade levels--in individualizing mathematics instruction. However, the data show that there is considerable room for improvement in this area, and teachers need to be given a clear idea of what is expected of them. Achievement test data are somewhat encouraging regarding the potential impact of the system. In this regard, data on change with increased time in the system are especially promising.

The assessment component is not working in either the computer terminal or paper and pencil schools. Both types of schools report backlogs of students being unable to receive timely feedback from the assessment measures and problems brought about by the system's present inability to allow students to "skip around" within a given series of objectives, i.e., bypassing those which he/she is having difficulty with. Observers further report that security problems exist. In addition, at least one assessment principle--that of waiting a week between instruction and assessment--appears somewhat questionable. Finally, while not within the scope of the present study, the fact that the assessment system is seriously overloading a massive computer system while serving only a very limited number of students is another indication that all is not well.

The computer reporting system is not providing information of maximal utility. The reports are perceived as redundant and are used in a fairly undifferentiated fashion.

# CHAPTER 3

## RECOMMENDATIONS

Detailed recommendations regarding modifications in ISM have been made at the end of each section in the findings chapter. Presented below is a comprehensive list of these recommendations:

### The Instructional Component

The instructional component has many sound features. However, if ISM is to realize its potential, a far greater emphasis must be placed on individualization of instruction within the system. The basic assumption underlying the use of a system of computer managed instruction is that computers are more efficient than manual methods of keeping track of the progress being made by individual students working in different segments of a course at different rates of progress. If instruction is not, in fact, being affected by such data, then the use of the computer ceases to be an educational benefit.

Given the fact that an important objective underlying the implementation of ISM was to increase individualization of instruction, the answer appears to be to place renewed emphasis upon helping teachers understand and implement individualized techniques. We suggest that the best means of doing this are the following:

- Make it clear to teachers, principals, and teacher specialists, especially in the junior high schools, that individualization of instruction is important to the success of children in the program. Instruct principals that in their monitoring of ISM they should look for and support behavior which contributes to individualization and its goals.

- Offer sufficient inservice training opportunities in the individualization of math instruction to ensure that all teachers have the opportunity to develop the required skills and that all principals are qualified to assess the efficiency of the individualized instructional activities in ISM schools.
- Examine the problems related to time for instructional preparation and assist teachers in decreasing the burden it imposes.
- Require that the Department of Instructional Planning set forth objectives for observed individualization of ISM instruction at both the junior high school and elementary levels; develop a plan for conducting formative evaluations of the progress made in meeting these objectives at each ISM school; and report annually on the results of their formative evaluation activities. Under such a plan, the goal for this year might be that 80% of elementary instruction and 50% of junior high school instruction might be observed as being individualized (using number of groups, number of objectives being worked on, etc. as criterion); that the percentages increase to 85% and 70% next year; and that they be 90% thereafter.
- Hold the Department of Educational Accountability responsible for periodically conducting its own evaluations of individualization and reporting its findings to the superintendent.

Analyses of attitude data indicate that many aspects of the instructional system are perceived as beneficial. Reports show that the content of the instructional system, especially the curriculum and instructional guides, appear to be sound and satisfactory to teachers and administrators. There is no reason why expansion

of this component of the system to additional schools should not be continued.

Analyses of achievement test data provide modest encouragement. Given the facts that the reported data were from a small sample of schools, that we were not able to analyze the degree to which the ISM schools outscored, or were outscored by, Non-ISM schools in previous years, and that an erosion in scores during the early years of a significant innovation is both common and expected, we are not concerned about the test score pattern. It should be expected that test scores will show improvement with increased years in the system, especially if the problems relating to individualization and assessment can be corrected in a timely manner.

We would emphatically state that the test scores reported in this section do not support an argument to curtail use of the system or contain it to the present set of schools.

The Assessment Component:

The problems uncovered in the assessment component are especially critical to the success of ISM because a strong case can be made that an assessment component is the most crucial component of an instructional management system; and that if the assessment is ineffective, one is left with nothing more than a curriculum package that may, or may not, be implemented in the manner in which the designers intended.

In the case of ISM, we have gathered ample evidence that not only is the assessment component functioning ineffectively, but that it is suffering from a limited number of design flaws which appear to be

counter-productive to sound instructional and data processing practice.

Further, many questions have been raised regarding the structure and adequacy of tests currently being used. Of central concern is their constructed-response format and the scoring burden it imposes. It is also unclear that the alternative forms of tests which are used interchangeably are, in fact, measuring the same things. Finally, the use of mastery tests for diagnosis suggests that some modification in placement tests, (their content and frequency) might be needed.

Given these facts, it is especially impressive that the overall system is perceived as positively as teacher and administrator input indicates. One can only speculate about the level of support, and the instructional gains, which should be demonstrated when the flaws in this most critical assessment component are corrected. In addition, we feel that another problem is that all the issues which need to be addressed in redesigning the assessment component were not addressed in this, or the previous, study. For example, we do not have evidence as to whether the computer terminal method of conducting assessments is more or less effective than the paper-and-pencil method; we have no idea as to which method is less costly; we have no evidence that the instructional value of constructed responses is superior to that of forced-choice responses; and we have no evidence that using the aides for scoring and/or for data input is more effective than would be centralized scoring and data entry. All of these types of issues should be addressed before any redesign of the assessment component is finalized.

Given these considerations, we recommend the following:

o Until mechanisms for increasing the flexibility of the assessment

component and relieving the input "gluts" are put into place, no further expansion of the assessment component should be permitted, and no new computer terminal schools should be added, even where currently planned for January of 1979. Thus, while findings provided earlier in this report strongly support the further expansion of the instructional component of the system, we feel that the new schools should only implement the instructional component until repairs can be made on the assessment component. We also suggest that this will permit a far smoother expansion of ISM, since the teacher specialists will be able to concentrate upon supporting the use of the instructional guides and instructional objectives, and increasing the use of individualized and small group instruction, rather than having to train teachers and aides in the use of the assessment component.

We suggest that until most of the problems with the assessment component are repaired, teachers in the new schools merely be provided with the assessment materials and encouraged to use them and keep their own informal records. Since this is largely what is being done in the present set of ISM schools, we do not view this as working a particular hardship on new teachers.

- The superintendent should place the highest priority on redesigning and reconstructing the assessment component with the objective of having a modified assessment system in place by September, 1979, and a finalized version available a year later. We would suggest that the schools added to the system in January, 1979, become the pilot group for implementing the September, 1979 versions; and that the remaining new schools, plus the schools now using the automated assessment components, be brought over to the new assessment system in September, 1980.

- By January, 1979, some possible variations in assessment procedures should be established in the present set of automated schools on a pilot basis so that the effects can be evaluated in the Department of Educational Accountability's study this spring. Of particular importance is exploring the feasibility of using forced-choice assessment instruments and machine scoring on optical mark forms. Of secondary importance is determining whether centralized scoring and processing of assessment measures in paper-and-pencil schools and in the lower grades in terminal schools is more efficient and cost-effective than is having each school do its own processing.
- Formative evaluation of the assessment tests themselves should be conducted. This evaluation should include, but not be limited to, an examination of the equivalence of alternative test forms; and an analysis of the adequacy of the placement tests.
- With the exception of the planned variations described above, schools now using automated assessment procedures--whether terminal-driven or paper-and-pencil--should continue to do so in the manner to which they have become accustomed; except that as components of the redesign effort become available, they should be installed as quickly as possible.

The Computer Reporting Component

The fact that the same reports are provided to principals and teachers immediately makes the efficiency of the reporting component suspect. One would expect that principals need summary and trend data provided in a concise manner at either the class or grade level of reporting. They should not be receiving reports at the student level of reporting.

Another indication that some revisions are probably called for is the fact that both teachers and principals report using the different kinds of reports for essentially the same purposes. This suggests that the reports should be redesigned so as to reduce their number and permit the needed planning data to be obtained from a single source for teachers and a single source for principals. The development of reports which can serve additional purposes, for which none of the present reports are being used, is probably also indicated.

Finally, some attention has to be given to the issue of frequency. Depending upon the format and purposes of a given report, it might best be provided more frequently than is presently the case, or less frequently. As reports are developed to serve different needs, the issue of frequency should be examined carefully, since this has significant effects on the redesign of the assessment component.

# CHAPTER 4

## IMPLICATIONS FOR CONTINUED GROWTH

According to present plans, 20 new schools will be added to the ISM program in January, 1979. Expansion of the program to all Grades K-8 is planned for the 1979-80 school year. On the basis of the findings reported here, the Department of Educational Accountability is strongly recommending that this schedule be maintained as planned, on the condition that new schools adopt only the instructional component--the curriculum and instructional guides--at that point in time and that the highest possible priority be given to redesigning the assessment and reporting components.

## CHAPTER 5

## RESPONSES TO FINDINGS AND RECOMMENDATIONS

A. Response from the Department of Management Information and Computer Services

The Department of Management Information and Computer Services basically concurs with this evaluation of ISM and endorses its recommendations. It is felt, however, that further elaboration on the historical aspects of ISM's development vis-a-vis design responsibility and technical/implementation expertise must be addressed for the reader to fully appreciate the system. Similarly, an understanding of this history should serve as a key step in implementing both the recommended revisions of ISM, and in avoiding similar pitfalls in the implementation of other instructional systems.

Use of computers to assist in the direct instructional process of MCPS began in 1968 with the installation of an IBM mini-computer at Einstein High School. This federally supported project developed and utilized Computer Assisted Instruction modules in the math and science areas. When this project's funding terminated ca 1971, IBM contributed the computer rent free except for MCPS funded equipment maintenance. That system, and project team, remained in place until the 1973-74 school year. The then office of Planning, Management and Computer Services (now DMICS) managed the project and assumed personnel responsibility for the staff.

The withdrawal of IBM funding of the 1500 (and a joint MCPS/IBM SIS study of 1972-73) lead MCPS to the decision to consolidate all computer applications into a single system. By year end 1974 the IBM 370 was installed and the staff of the CAI project rehoused at the ESC. At that time it was decided that CAI was more "educational" than "technical" and the new Division of Computer Related Instruction was assigned to the Department of Curriculum and Instruction.

As noted on page 1.2, LCMSS and ISM were developed after the Division of Computer Related Instruction (then called Division of Computer Assisted Instruction) was separated from OPMCS. A review of the MCPS FY75, 76 and 77 adopted budget documents reveals that no staff were budgeted in OPMCS/DMICS to support this effort. As such, the work of DCRI is to be commended for producing as much as it did with little technical direction or professional data processing consultation.

Given the fact that non-computer professionals, i.e., part-time instructional programming and teacher-specialists, created the system, it is not unexpected that the high quality of the curriculum aspects of ISM are not mirrored in the delivery system (assessment and reporting modules). With little or no budget for technical analysis and design, and with management demands for quick delivery of a "systems approach" DCRI often made technical decisions that were less than optimal for a full systems implementation.

Based upon the history of this project, it is the recommendation of DMICS that future development of the ISM technical delivery vehicles for assessment and reporting components be the responsibility of DMICS. We further recommend the immediate transfer of technical staff from DCRI to DMICS for this purpose.

B. Response from the Department of Instructional Planning and Development

1. Introduction

The members of the Department of Instructional Planning and Development are pleased to submit the following statement in order to further the refinement of the Instructional Systems Mathematics program.

We have had the opportunity over the past two days to review "An Evaluation of the Instructional System in Mathematics: 1977-78" by Joy A. Frechtling. We believe that our input will be helpful in light of the acknowledgement in the report that its data sources are limited in scope and less than satisfactory in format.

Moreover, this paper will reflect as many of the issues indicated on the attached page as was possible in the time available.

2. Definition of Individualized Instruction

The evaluation paper refers frequently to "individualized instruction" and cites it as a goal of ISM. It is important to understand clearly what definition of individualized instruction is intended here. It is not the intent of ISM that students should continually work alone on worksheets, books or other instructional materials. It is the intent of ISM to recognize the fact that learning is always individual, no matter what the size of the instructional group may be. Instruction should, therefore, be designed to maximize individual learning. Many concepts and skills can be acquired with great efficiency while interacting with other learners. Instruction should be presented at a level which matches closely the achievement level of the student, but it is effective occasionally to also present advanced objectives which are above the achievement level of the student. It is also important to review major ideas which were learned earlier. Thus individualized instruction in ISM means instruction which meets the needs

of the individual. It is most often accomplished through small group organization in the classroom.

3. System Components

Curriculum

The 370 objectives in the mathematics curriculum have been organized into 24 categories and sequenced and leveled within each category. About 170 of the objectives are labeled as key and are formally assessed. Each key objective has been selected because it represents a concept or skill which is essential to subsequent learning and also tests between two to five intervening objectives.

Each category, except for BASIC FACTS, must be assessed (but not necessarily taught) in the order suggested by the system. Using the basic tenets of instructional technology as supported by Gagne, Bloom and Mager, each category was subjected to a rigorous task analysis to determine the relationships between objectives. The learning of intellectual skills is predicated on mastery of lower order skills while the learning of facts appears to be independent of prior factual learning. (p. 110 Mastery Approach to Competency-Based Education.) Where no one sequence appeared to be valid, the usual order of teacher and textbook presentation was imposed. In addition, objectives on which the assessment requires students to demonstrate understanding by using concrete objects precede the paper and pencil form of the same skill. The report recommends that the present organization of the curriculum be abandoned. This idea seems inappropriate for all categories but for those categories which are not necessarily sequential (e.g. Geometry) an optional way of testing clusters of objectives has been underway and was one of several options presented to the Executive Staff on changes to ISM in April, 1978.

Mastery Test Time Period

The model of computer-managed instruction presented in the report, which says that waiting a week is highly suspect and that children should be taught and tested, was considered and rejected from a pedagogical point. That method of teach-test was unacceptable because it allowed no time for students to integrate the new learning and no opportunity for teachers to observe the child's use of the skill over a period of time. The use of the class profile reports is intended to assist teachers in long- and short-range planning. The intention of the system is for students to receive instruction on two to five related categories over a period of several weeks and then be tested. Instruction on a new set of categories would follow with its testing and teachers would return at regular intervals to the topics previously taught. Therefore, embedded in the teachers' long-range plans is the regular reteaching of categories during the school year. As previously taught topics are reintroduced, new objectives are taught to the advanced students and reteaching and review used with students who have had difficulty.

Record Keeping and Reports

Teachers do not need to keep their own records and from the observations of teacher specialists and administrators most are not. The report on teacher use of computer reports, Table 16, bears this out as over 65% of teachers use the class profile to group students once a month or more often and the same percentage use these reports for long-range planning. The report states that 78% of the students interviewed said they remained in the same group all year. That means teachers have determined that 22% need to be regrouped for different topics instead of remaining with the slow, average, or fast group all the time. The practice of regrouping for different categories is a new idea for many teachers. The fact that almost one-fourth of the

students have experienced grouping changes is very encouraging. The student profiles are used by over half the teachers for assignment of grade and working levels as well as conferencing with parents. Additional inservicing on use of reports is necessary, however, as misuse or misunderstanding about the use of the reports (e.g., using a class profile with parents) by a number of teachers and principals is evident.

Two problems have been under study since January and are receiving continual attention. One is the amount of additional planning time for teachers and the unusually heavy burden on the aides in large schools. The System is intended to provide supports to allow teachers more time to teach. Many have been unable to give up their own record keeping which is redundant. The assessment provides valid tests and, where computer support is available, no manual grading is required.

Assessment

The most serious problem and one addressed in a paper to the Executive Staff last spring, is the problem of computer support. Alternative methods of assessment are being planned which will reduce the burden on the computer. However, it appears that only a certain percentage of the curriculum lends itself to multiple-choice tests. A substantial number of objectives can only be tested by demonstration or construction. Even with objectives which can be tested by multiple choice method, the questions remain as to whether students can do long division if they can choose the correct answer from a choice of 4-5 distractors. The ISM staff will be studying those objectives which lend themselves to alternate ways of testing.

4. Selected Reactions to Chapter 2

The report as presented raises questions which appear to arise from the data. It should be kept in mind though, that the data themselves may have to be

more carefully screened to obtain a meaningful analysis. An example of this is in Table 3 dealing with Distribution of Respondents by Computer Terminal Availability. More teachers responded from schools not having computer terminals than from schools having computer terminals. This is despite the fact that there were far less schools without computer terminals. Why are the data skewed in this way? What effect might this have on the results of the analysis?

Instructional Practices

The recommendation on page 2.13 says, "in too many classes instructional practices appear unaffected." What was the standard for the value judgment of "too many?" One could look at it another way and conclude that if instructional practices changed in as many as 56% or even as few as 12% of the classes -- which might be inferred from Table 8 on Use of Instructional Materials -- then the change in instructional practices is significant. Table 4 on Comparisons for First Year Teachers on Time Spent on Preparation seems to support this through teacher perception of change.

Achievement

Since the Iowa Tests of Basic Skills only measure about 40% of the ISM objectives, and since about 10% of the ITBS items do not relate to ISM objectives, it may be unrealistic to expect significant improvements in those scores. It would be better to have an instrument which is based on the ISM objectives or, at the least, search for a standardized test which reflects ISM objectives and use it as a criterion.

Mastery

It should be pointed out that the definition of mastery as used in ISM goes beyond immediate recall. For that reason teachers are asked to have students assessed on an objective one to two weeks after instructional activities have

given strong indication that learning has occurred. It has regularly been stressed that the ISM key objective assessment and reports are aimed at assisting with long-range planning and not at day-to-day lesson development. Teachers do have immediate feedback on whether students have passed the mastery assessments, but this is on an individual basis and would be too late for daily instructional planning. Informal tests and quizzes in the classroom would be more useful for this purpose, but these need not entail extensive additional records since they will be used only for the short term plans.

Effect of Time

The report does not differentiate well between first and second year teachers and aides in their practices. It also does not make any attempt to differentiate practices which are fostered by the nature of the system and practices which are the result of lack of success in the in-service training program. This could be a very serious defect in the study.

Hierarchies

The discussion of the category hierarchies hits on an assessment concern which has been the object of many discussions within the ISM staff since the development year (1976-77). Some changes have already been made in the single year that was available to try and alleviate what was known to be a problem. Between the 1976-77 school year and the 1977-78 school year, the basic facts objectives were put into a separate, non-hierarchical category. Also, the number of key objectives (those formally assessed) was reduced by 20%. Between 1977-78 and 1978-79, the number of key objectives was reduced by another 10%. These reductions in the number of key objectives lessen the chance of having a student tested and being successful on objectives which are taught in a different sequence. Even given this fact the staff still

recognized a significant potential for problems in some categories. As a result, during the summer of 1978, a committee of classroom teachers, area teacher specialists, and resource teachers worked on a recommendation for revising the assessment procedures in the geometry and measurement categories. These are categories in which the sequence is primary arbitrary. The report of that committee is to be studied for possible implementation in 1979-80.

One caution should be kept in mind as the sequences are studied in some of the computational categories. It is possible for many students to learn to do their computational algorithms without demonstrating any understanding of that algorithm or the conditions which give rise to it. Learning of this type will not support the student's later need to apply that computation in problem solving situations, nor to generalize it to higher mathematics courses. The view that a non-hierarchical management system is necessarily better is unduly simplistic.

5. Recommendations

As discussed in the above sections, there is little data supporting the fact that the assessment component, consisting of placement and mastery tests designed to provide uniform assessment of a selected number of objectives and information regarding individual student progress, is not meeting its intended purpose. However, recognizing that the management of the assessment process has created a burden on the instructional aides and the MCPS computer system the following alternatives which have been under study since the end of the development year are being considered for implementation in September, 1979:

1) clustering of objectives for assessment purposes in categories which do not lend themselves to a hierarchical sequence

2) investigation of alternate methods of collecting assessment results in the central computer system

3) alternate forms of assessment tests in paper and pencil form, such as multiple-choice items, self-checking forms, and combination of multiple-choice and constructed answers within a category

An alternate plan for implementation in February, 1979, would be to place the instructional component with no assessment or reporting components in 16 of the 21 schools. The remaining five schools would assist in developing and piloting an assessment component which would alleviate the problems identified by the ISM staff during the initial two years. Certain of these ongoing problems have been confirmed by this report. Additional concerns which are under study are described below.

As the system expanded from 15 schools to 33 and now to 56 schools, the staff development requirements greatly increased. No data are available in this report on the effects of the past in-servicing on ISM. However, informal observations, feed-back sessions, and area input indicate that changes are necessary. A committee composed of area, school and central office personnel is in the process of providing a number of options for in-servicing school staffs on each instructional system. This report will be completed by December 31, 1978.

A major concern has been the ability of the central computer to support the instructional systems. The IBM language, COURSEWRITER III, has been used in MCPS since 1974 for instructional programming. This language is inefficient and does not provide a suitable vehicle for computer-managed instruction. In addition, the present computer cannot support any

additional terminals. An alternative use of microcomputers for ISM was presented by staff in our April report to the Executive Staff. Following several sessions with consultants, an inexpensive microcomputer was purchased to determine the feasibility of reprogramming ISM and one staff person from DMICS was assigned to this possibility. This alternative method has many attractive attributes, not the least of which is greatly reduced cost. The microcomputer within a school can provide four or more terminals and can be used for CAI, ISM, and programming. Our recommendation is that DMICS make this feasibility study a priority during the next few months.

One of the questions which has been asked repeatedly by ISM participants and observers concerns the question of retention. Do children who demonstrate mastery under the assessment practices of ISM retain those mastered objectives more or less completely than children who are in the non-ISM schools? The answer to this question has implications for both the assessment and instructional components of the system. The ISM staff developed a retention test during the summer of 1978. This test was used on an informal basis by second and third year ISM schools during the fall of 1978. Comments from the schools reinforce the importance of a more careful investigation of the retention issue. This investigation is recommended as a priority to the Department of Accountability. It should involve retention data gathered and analyzed from ISM and non-ISM schools.

The question of time required by teachers in planning their mathematics instruction is raised by the report. This again reinforces observations of ISM staff during the first two years. Teachers who reported this problem prompted the ISM staff to analyze the teaching-learning process as it operates in the system and to revise the in-service training program to

give teachers more guidance in this area. More emphasis was placed on long-range planning and on development of activities which would support independent investigations by students of ISM objectives. It is expected that skillful use of both of these techniques will make the planning burden lighter and will maintain a focus on meeting needs of individual students. Additional data need to be gathered from teachers whose training was aimed at improving these skills. If the problem has not been eased, then consideration needs to be given to materials, assessment or report modifications which will correct the situation. If the problem has been alleviated, then a plan must be devised for strengthening the skills of ISM teachers who began in 1976 or 1977. This investigation should be planned and implemented within the Department of Instructional Planning and Development.

We are in agreement with the Department of Educational Accountability's statement: "...we do not have evidence as to whether the computer terminal method of conducting assessments is more or less effective than the paper-and-pencil method; we have no idea as to which method is less costly; we have no evidence that the instructional value of constructed responses is superior to that of forced choice responses; and we have no evidence that using the aides for scoring and/or for data input is more effective than would be centralized scoring and data entry. All of these types of issues should be addressed before any redesign of the assessment component is finalized."

The Department of Educational Accountability has prepared a new research design and, in view of the above, might well implement the part of the design which would identify specific problems and possible solutions from the general problem area which seems to be indicated by the limited amount of

data currently available. The evaluation should also address any other issues which the superintendent and the Board of Education wish pursued during the remainder of this school year. As data are collected, the data and possible interpretations should be provided by DEA to the ISM staff on a continuous basis so that the necessary adjustments and improvements can be made.

## REFERENCE

Seitz, C. A., Instructional System in Mathematics, 1976-77: A Report on Responses to Five Questionnaires, Department of Research and Evaluation, Montgomery County Public Schools, September, 1977.